

We may formulate the general conclusions (1) that for observations in the daytime it is advisable to confine our choice of marks to black, or nearly black, objects against the horizon sky, rejecting marks which appear against terrestrial backgrounds; and (2) that the general adoption of some sort of transmission meter is desirable in order to make night measurements independent of local conditions.

It is felt that some standardization of technique on the lines here suggested would greatly improve the quality of observations of the visual range. It is a common opinion that observations of this element are of no use in synoptic meteorology. May it not be possible that this has been true in the past only because such data are not inter-comparable?

LITERATURE CITED

(1) Bergmann, L., "Ein Objektiver Sichtmesser." Phys. ZS. 35: 177-179, 1934.

(2) Buisson, H., and C. Fabry, "Photometre universel sans ecran diffusant." J. de Phys. 1: 25-32, 1920. Rev. d'Optique theor. et instr. 1: 1-12, 1922.

(3) Foitzik, L., "Sichtweite bei Tag und Tragweite bei Nacht." Met. ZS. 49: 134-139, 1932.

(4) Foitzik, L., "Ein neuer Sichtmesser." Met. ZS. 50: 473-474, 1933.

(5) Foitzik, L., "Messungen der spektralen Lichtdurchlässigkeit von Naturnebeln mit einem neuen Sichtmesser." Naturwiss. 22: 384-386, 1934.

(6) Koschmieder, H., "Theorie der horizontalen Sichtweite." Beitr. zur Phys. d. freien Atm. 12: 33-53 and 171-181, 1924.

(7) Koschmieder, H., "Danziger Sichtmessungen I". Forschungsarbeiten Staatl. Obs. Danzig no. 2, 1930.

(8) Koschmieder, H., "Measurements of visibility at Danzig." U. S. Mon. Weather Rev. 58: 439-444, 1930.

(9) Middleton, W. E. K., "The Measurement of visibility at night." Trans. Roy Soc. Canada Sec. III 25: 39-48, 1931, and 26: 25-33, 1932.

(10) U. S. Department of Agriculture, Weather Bureau, *Instructions for Airways observers.* (Circular N, Aerological Division.) Washington 1932, U. S. Government Printing Office. The reference is to page 24.

(11) Meteorological Service of Canada, *Instructions to Observers.* Ottawa 1930, F. A. Acland. The reference is to page 79.

CLIMATIC TREND IN THE PACIFIC NORTHWEST

H. G. CARTER, Meteorologist

[Weather Bureau, Boise, Idaho, January 1935]

Numerous studies have been made of weather conditions in various sections of the country in an effort to determine whether climate has undergone any progressive change in one definite direction within the memory of the present generation.¹ With the view of contributing to the data already collected for this purpose, the writer made a study of the weather in the Pacific Northwest.

The Weather Bureau records at Portland, Oreg., and Seattle, Wash., were considered as representative of the coast climate of the Pacific Northwest, and the records at Boise, Idaho; Spokane, Wash.; and Walla Walla, Wash., as representative of the climate of the interior stations.

PRECIPITATION

Table 1 gives the annual precipitation at each of the five stations from the beginning of the records down to and including 1933, and figure 1 shows graphically the same data. A glance at the chart emphasizes the variations in precipitation from year to year. Wet and dry years follow each other irregularly by no set rule. A study of the chart reveals the difficulty of finding cycles of wet or dry years. At Portland the unusually wet year of 1882 stands in sharp contrast to the dry year of 1929. The annual amounts, when represented in inches, show greater variations at the coast stations, as amounts for the year are larger than at the interior stations. It is interesting to note the frequent similarity in the trend of the graphs representing the amounts at the different stations.

TABLE 1.—Annual precipitation

Year	Portland	Seattle	Boise	Spokane	Walla Walla
1868			6.69		
1869			15.73		
1870			15.93		
1871			25.80		
1872	46.90		17.33		
1873	50.52		17.74		13.13
1874	46.17		14.97		11.84
1875	60.10		13.83		15.91
1876	54.94		11.12		17.32

TABLE 1.—Annual precipitation—Continued

Year	Portland	Seattle	Boise	Spokane	Walla Walla
1877	58.30		13.80		20.56
1878	47.70	42.69	9.02		13.64
1879	62.22	56.44	15.17		20.48
1880	51.87	42.92	10.66		17.71
1881	57.05	46.81	13.56	24.68	22.27
1882	67.24	36.71	14.43	25.99	20.87
1883	51.45	30.32	15.17	14.37	12.56
1884	38.31	30.35	21.05	20.56	20.61
1885	39.59	38.25	12.56	19.01	15.31
1886	38.76	31.13	12.23	15.86	16.20
1887	54.17	35.63	11.34	20.10	20.44
1888	38.76	34.77	11.06	17.69	13.59
1889	31.76	25.92	10.95	14.27	14.53
1890	40.38	26.94	12.53	16.57	11.80
1891	47.41	34.74	13.31	16.69	16.11
1892	32.58	32.49	11.75	16.78	16.94
1893	39.08	45.16	13.92	22.00	23.07
1894	39.32	41.08	14.12	17.84	20.49
1895	30.76	29.69	7.90	13.46	14.89
1896	44.13	42.83	22.95	20.32	19.41
1897	43.01	41.53	16.98	23.84	21.67
1898	35.90	29.28	8.85	13.08	16.34
1899	42.21	37.13	14.84	20.08	22.99
1900	38.22	36.48	12.77	18.72	18.89
1901	41.05	30.18	9.59	15.99	14.52
1902	50.15	45.78	12.15	19.23	18.88
1903	35.62	34.55	9.55	16.55	15.70
1904	46.37	37.73	14.08	13.97	18.13
1905	34.10	34.35	9.77	16.68	17.12
1906	43.29	36.67	14.19	17.60	19.13
1907	42.89	29.10	15.92	17.69	15.77
1908	34.37	28.25	12.33	12.02	11.66
1909	43.75	31.72	15.06	16.21	18.73
1910	38.65	34.20	12.07	15.44	16.82
1911	33.28	21.69	15.35	11.86	13.38
1912	43.47	35.14	18.10	18.21	20.36
1913	36.30	24.59	16.04	16.74	17.38
1914	36.67	31.43	8.60	13.56	13.60
1915	41.30	33.83	13.31	16.35	17.08
1916	45.77	34.61	14.64	15.75	21.32
1917	40.50	28.90	14.48	11.88	15.90
1918	31.50	29.21	12.73	9.92	12.25
1919	45.70	31.54	11.46	13.85	16.64
1920	41.17	32.21	13.57	12.18	18.43
1921	43.21	39.81	12.07	12.62	16.41
1922	38.76	25.27	12.00	11.51	11.15
1923	32.81	27.18	12.47	16.02	17.19
1924	31.22	30.73	8.66	12.25	13.06
1925	31.36	25.78	13.79	12.35	11.71
1926	41.17	26.12	11.65	14.52	17.90
1927	45.78	32.98	15.41	23.28	18.51
1928	34.69	25.60	9.53	10.56	12.44
1929	26.11	20.03	8.83	7.54	11.19
1930	27.16	21.78	14.46	11.84	13.22
1931	42.68	36.06	9.41	13.61	16.87
1932	39.98	34.28	13.09	15.85	14.76
1933	52.85	44.91	7.95	14.91	16.22
Average	42.25	33.66	13.22	16.05	16.61

¹ Kincer, J. B.: Is Our Climate Changing? A Study of Long-Time Temperature Trends. MONTHLY WEATHER REVIEW, vol. 61, September 1933, pp. 251-269.

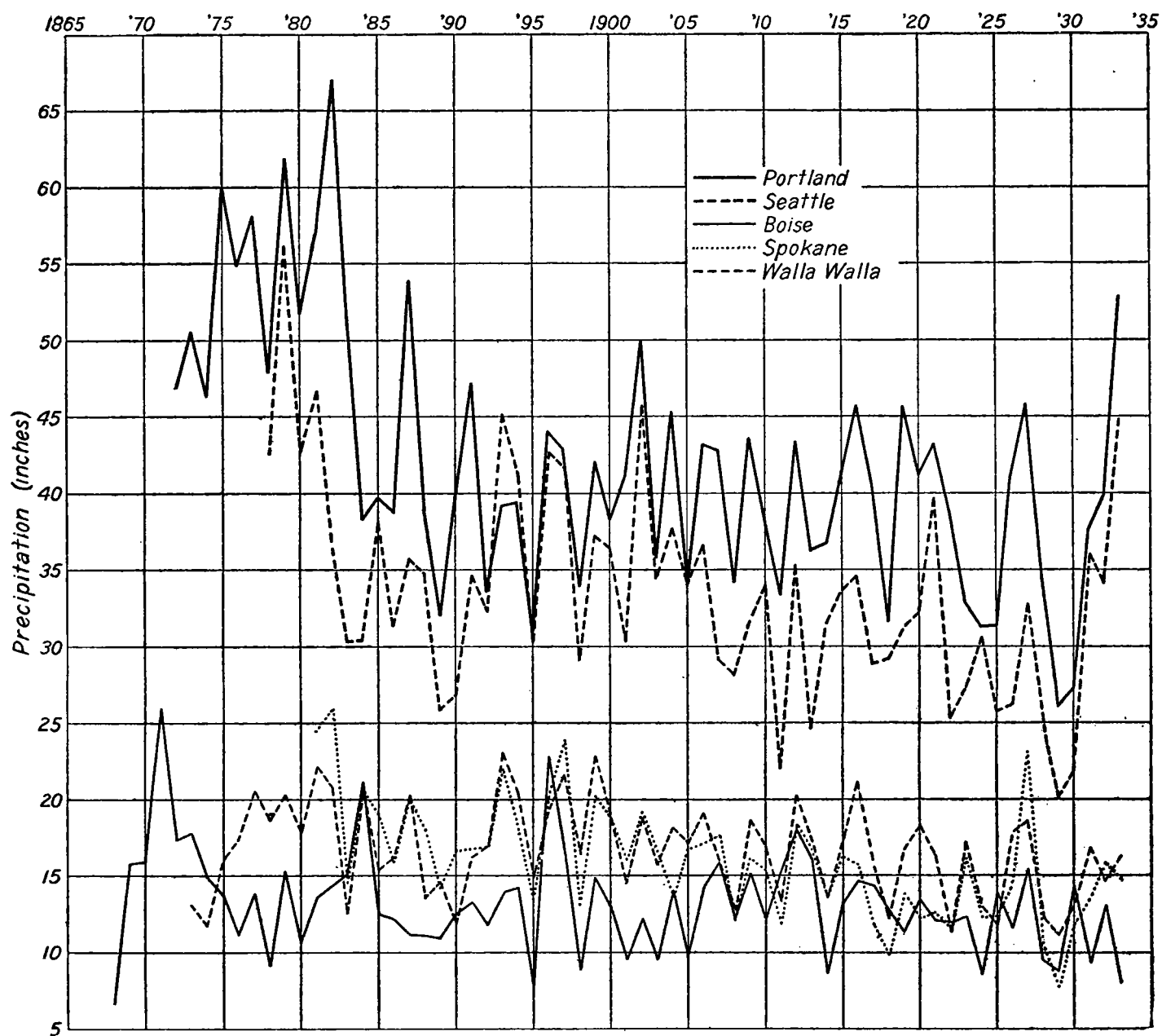


FIGURE 1.—Annual precipitation from the beginning of observations to the end of 1933.

Figure 2 shows sliding 10-year averages of precipitation for each of the five stations. These values were determined by taking the average of 1 year and the preceding 9 years. For example, the value for Portland for 1881 is 53.6 inches; this is the average for the 10 years ending 1881. The value for 1882, 55.6 inches, is the average for the 10 years ending 1882, etc. A uniform downward trend during the last 10 or 15 years is noted for all stations, and for longer periods at some of the stations. The lowest point reached for Portland and Seattle is in 1931; for Boise, 1933; for Spokane, 1926; and for Walla Walla, 1930.

At Portland the wettest 10 consecutive years were 1874 to 1883, when the average rainfall was 55.70 inches, or 132 percent of normal; the driest 10 consecutive years were 1922 to 1931, with an average of 35.17 inches, or 83 percent of normal.

At Seattle, the wettest 10-year group was from 1878 to 1887, with an average of 39.12 inches, or 116 percent of normal; the driest, was from 1922 to 1931, with 27.15 inches, or 81 percent of normal.

At Boise, the wettest 10-year period was from 1869 to 1878, with an average of 15.53 inches, or 117 percent of normal; the driest, from 1924 to 1933, with 11.28 inches, or 85 percent of normal.

At Spokane, the wettest 10-year period was from 1881 to 1890, with 18.91 inches, or 118 percent of normal; the driest, from 1917 to 1926, with 12.71 inches, or 79 percent of normal.

At Walla Walla, the wettest was 1893 to 1902, with 19.12 inches, or 115 percent of normal; the driest, from 1921 to 1930, with 14.28 inches, or 85 percent of normal.

TEMPERATURES

Table 2 gives the mean annual temperature for the five stations from the beginning of records up to and including 1933, and the same data are presented graphically in figure 3. A slight upward trend will be observed during the last two decades. Figure 4 shows the sliding 10-year averages. The values used in preparing this chart were obtained in the same manner as that used in obtaining precipitation values in figure 2.

TABLE 2.—Annual temperatures

Year	Portland	Seattle	Boise	Spokane	Walla Walla
1868			50.4		
1869			54.6		
1870			52.6		
1871			52.9		
1872			53.1		51
1873			52.9		53
1874	53.4		54.6		52
1875	53.2		52.6		52
1876	53.0		52.6		53
1877	53.2		52.4		55
1878	53.0		52.4		54
1879	52.4		51.4		51
1880	50.9		48.9		50
1881	52.9		50.0	47.3	51
1882	52.7		48.6	46.5	51
1883	52.9		48.7	46.8	51
1884	52.6		50.0	45.4	50
1885	55.6		52.1	50.1	56
1886	53.6		50.8	48.7	54.4
1887	52.3		51.4	47.2	52.9
1888	53.8		52.0	48.7	54.2
1889	54.8		52.2	49.1	54.3
1890	52.2		49.3	47.4	52.8
1891	53.7		49.5	49.0	54.2
1892	52.9	53.8	49.3	48.4	53.8
1893	50.1	50.2	48.4	45.7	50.6
1894	51.9	50.4	50.6	48.2	53.0
1895	52.0	51.2	49.4	48.0	53.1
1896	52.6	51.1	50.5	48.6	53.5
1897	53.1	51.5	50.9	48.2	53.1
1898	52.6	52.2	49.3	48.2	53.2
1899	51.9	51.3	50.0	47.2	52.4

TABLE 2.—Annual temperatures—Continued

Year	Portland	Seattle	Boise	Spokane	Walla Walla
1900	53.5	52.8	52.5	49.8	54.4
1901	52.6	52.0	52.5	48.8	53.3
1902	52.6	52.2	51.1	47.9	52.4
1903	52.9	51.2	50.8	47.5	52.5
1904	54.3	52.4	53.0	49.9	55.1
1905	53.3	51.9	50.9	48.2	
1906	54.4	52.5	51.5	49.4	54.9
1907	53.6	51.1	52.0	47.6	
1908	52.9	50.9	51.0	48.8	54.2
1909	51.8	49.7	51.5	47.4	52.4
1910	53.3	50.9	51.8	49.6	53.9
1911	52.2	50.2	49.7	47.8	52.9
1912	53.4	51.5	49.5	47.8	53.1
1913	52.8	50.6	49.9	46.9	52.2
1914	54.4	52.2	52.1	49.6	54.2
1915	54.8	52.8	52.0	49.9	54.7
1916	51.5	49.2	49.6	45.9	50.0
1917	54.0	50.8	50.8	48.6	54.3
1918	54.8	51.6	51.9	50.2	55.2
1919	52.7	50.4	50.6	47.7	52.6
1920	52.9	50.6	50.5	48.7	52.8
1921	53.8	50.5	52.2	48.9	53.9
1922	52.2	49.9	50.2	47.3	52.2
1923	54.5	51.9	51.2	49.0	54.2
1924	53.7	51.5	50.7	49.1	53.7
1925	55.3	52.6	53.0	51.1	56.5
1926	56.8	54.0	53.4	50.6	56.0
1927	53.8	51.5	51.4	48.0	53.3
1928	54.1	52.2	51.6	49.5	54.0
1929	53.2	50.9	50.0	47.2	51.9
1930	53.2	51.3	50.2	48.7	52.7
1931	55.2	52.8	52.0	50.0	54.4
1932	54.2	51.7	50.3	48.7	53.8
1933	53.4	51.6	51.7	49.0	54.5
Average	53.3	51.5	51.2	48.4	53.2

At Portland the warmest 10 consecutive years were 1923 to 1932 (fig. 4) with an average annual temperature of 54.4°, while the coldest were 1893 to 1902, with an average annual mean of 53.2°. At Seattle the warmest 10 consecutive years were 1923 to 1932, with an average mean of 52°, and the coldest were 1913 to 1922, with a mean of 50.9°. At Boise, the warmest 10 consecutive years were 1869 to 1878, with a mean of 53.1°, and the coldest were 1890 to 1899, with a mean of 49.7°. At Spokane, the warmest were 1924 to 1933, with a mean of 49.2°, and the coldest were 1881 to 1890, with 47.7°. At Walla Walla, the warmest were 1917 to 1926, with 54.1°, and the coldest 1875 to 1885, with 51.8°.

When considered by seasons, the data indicate that the springs have been getting warmer during recent years at all five stations. Summers were cooler at Boise during the last 10-year period, but at other stations they were warmer during the last 2 decades, and at Portland, Seattle, and Walla Walla during the last 3 decades.

Autumns show but little change during the latter part of the record, Portland, Seattle, and Boise being slightly warmer, Spokane slightly cooler, while at Walla Walla there was but little change.

The average recent winter temperatures show no change at Portland. At Seattle, Walla Walla, and Spokane they were slightly higher than during the preceding 10 years, while at Boise they were lower.

The data presented in this paper, while indicating the weather of the past, is not to be considered necessarily as an indication of that for the future, except that the usual trend of weather, after a period of departures from normal conditions, is to again swing back to normal. The moderately warm and relatively dry weather of the past decade or so in the Pacific Northwest, is abnormal, and if future conditions follow past performances, it would appear reasonable to expect a return to normal conditions. The data are not to be interpreted as indicating an indefinite continuation of temperatures above normal and precipitation below normal.

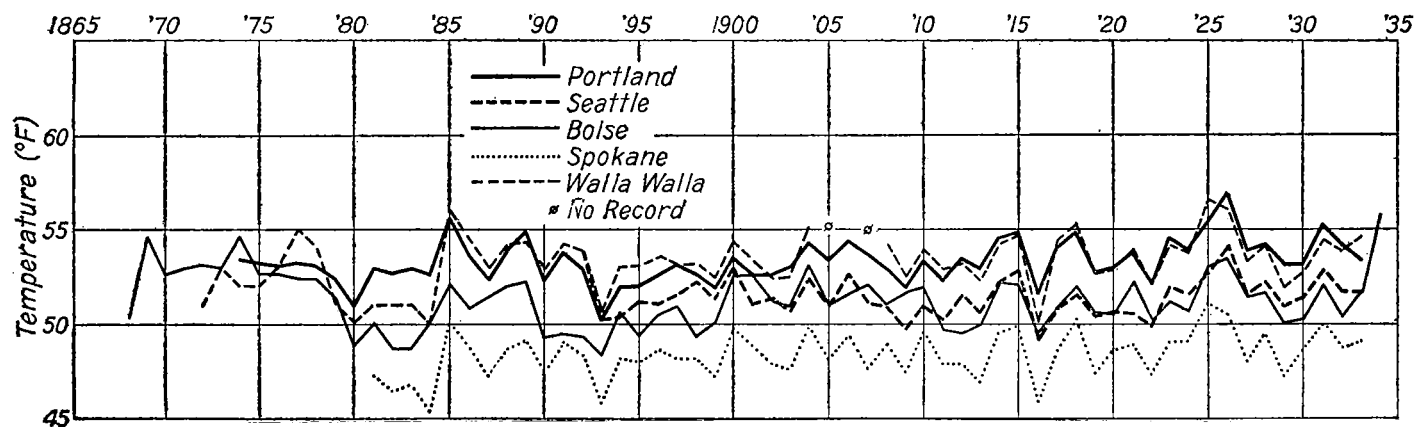


FIGURE 4.—Sliding 10-year mean annual temperature averages from beginning of observations to the end of 1933.

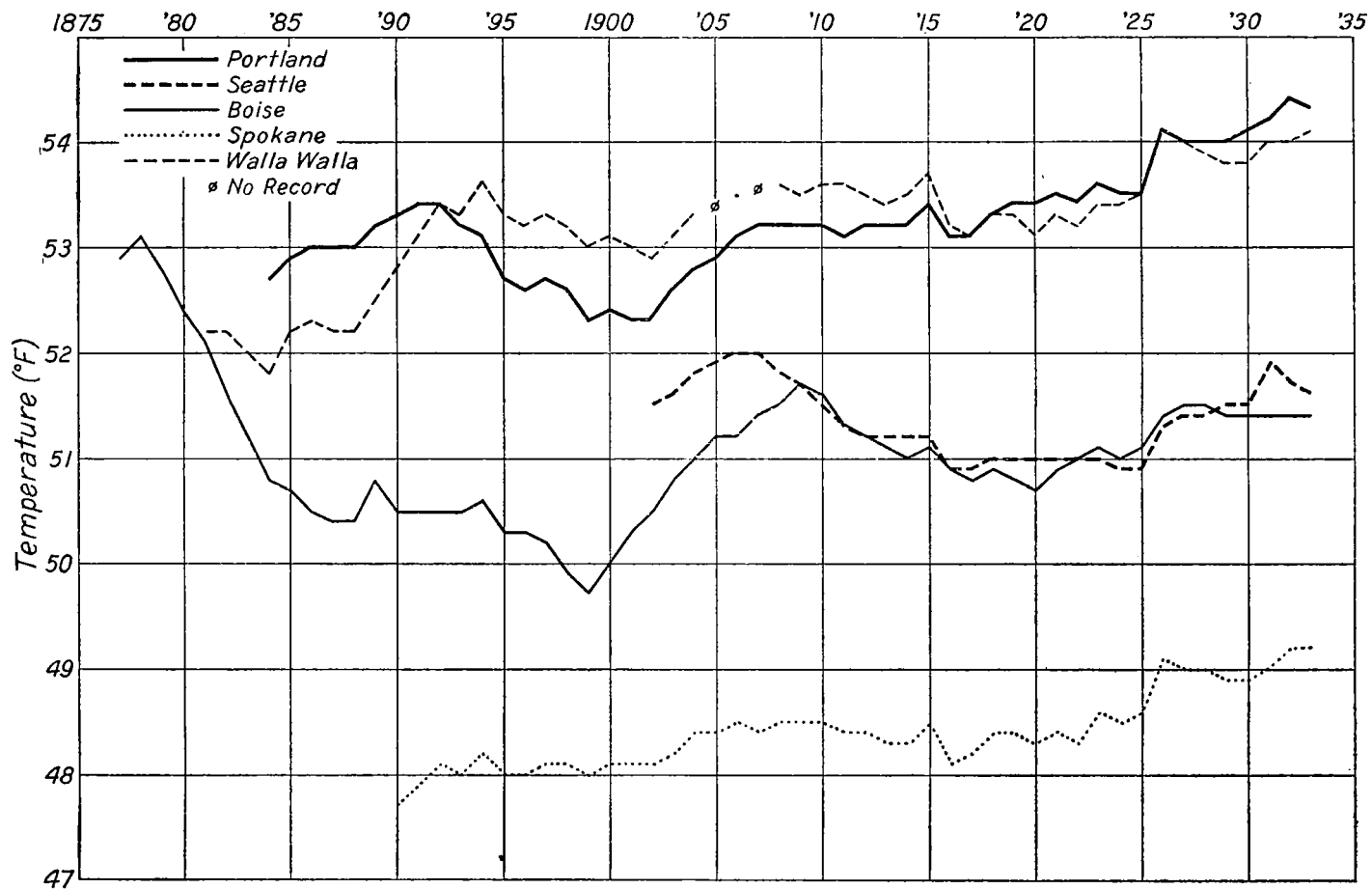


FIGURE 3.—Mean annual temperatures (F.) from the beginning of observations to the end of 1933.

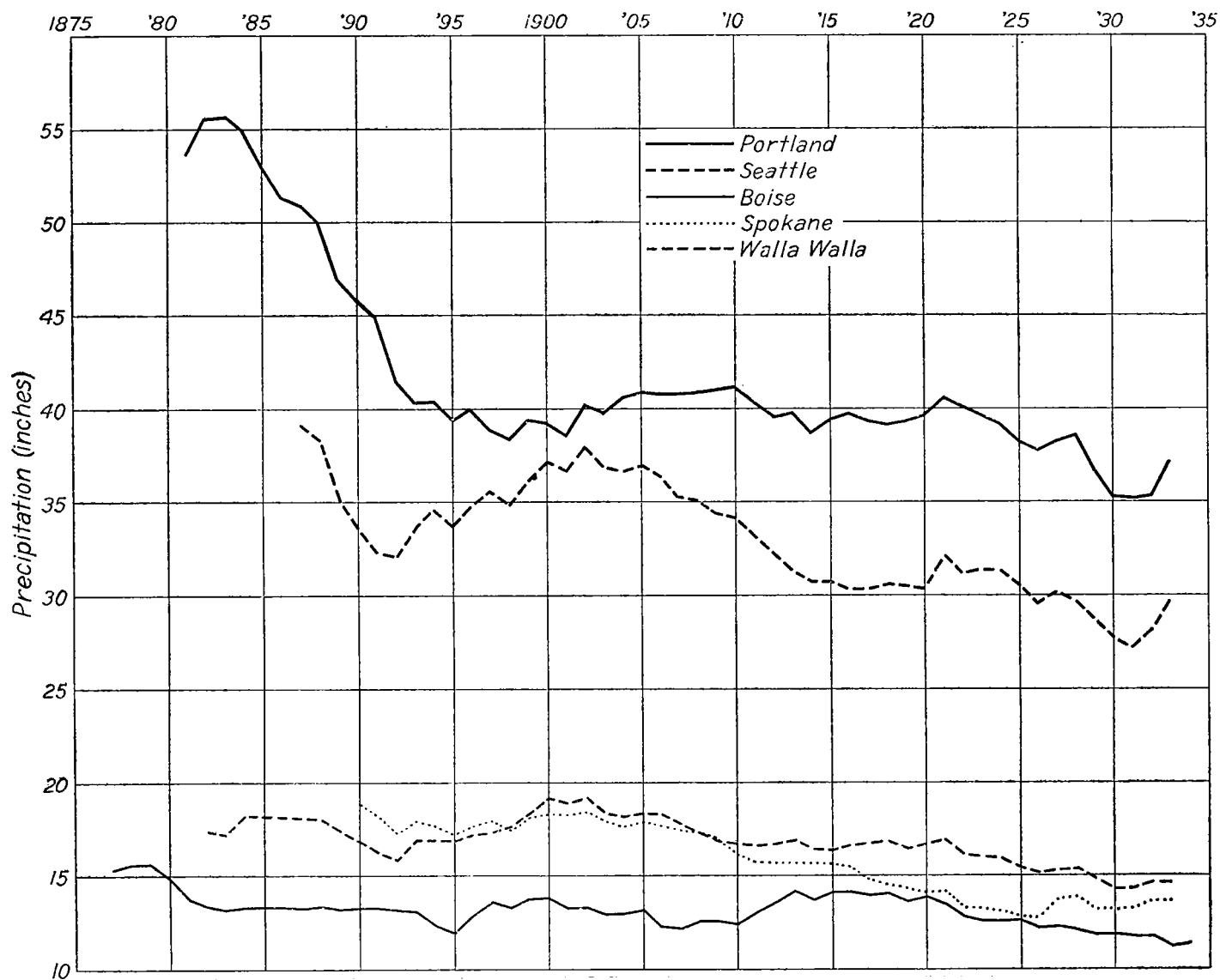


FIGURE 2.—Sliding 10-year precipitation averages from beginning of observations to the end of 1933.